

WHAT IS CLAIMED IS:

1. A method for producing a fine structured member on a substrate, comprising:

a step of forming a positive-working
5 photosensitive material on a substrate;

a step of heating the layer of said positive-working photosensitive material thereby crosslinking the positive-working photosensitive material layer;

a step of executing an irradiation with an
10 ionizing radiation of a wavelength region capable of decomposing said crosslinked positive-working photosensitive material layer on a predetermined area of said crosslinked positive-working photosensitive material layer; and

15 a step of removing, by a development, the area irradiated by the ionizing radiation of said crosslinked positive-working photosensitive material layer from the substrate, thereby obtaining a non-irradiated area by the ionizing radiation of said
20 crosslinked positive-working photosensitive material layer as a fine structured member having a desired pattern on said substrate;

wherein said positive-working photosensitive material includes a ternary copolymer containing
25 methyl methacrylate as a main component, methacrylic acid as a thermally crosslinkable factor and a factor for expanding a sensitivity region for said ionizing

radiation.

2. A method for producing a fine structured member according to claim 1, wherein the crosslinking
5 by said heat treatment is caused by a dehydration condensation reaction.

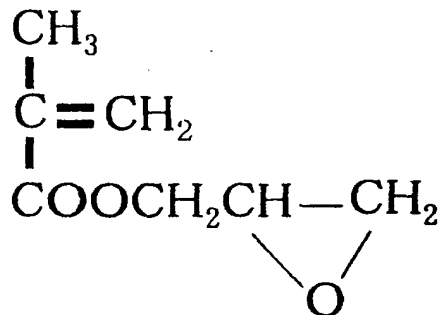
3. A method for producing a fine structured member according to claim 1, wherein said factor for
10 expanding the sensitivity region is methacrylic anhydride.

4. A method for producing a fine structured member according to claim 3, wherein said ternary
15 copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization of cyclized polymerization type at a temperature of 100 to 120°C employing an azo compound or a peroxide as a
20 polymerization initiator.

5. A method for producing a fine structured member according to claim 3, wherein said ternary copolymer has a weight-averaged molecular weight
25 within a range from 5,000 to 50,000.

6. A method for producing a fine structured

member according to claim 1, wherein said factor for expanding the sensitivity region is glycidyl methacrylate represented by a following formula:

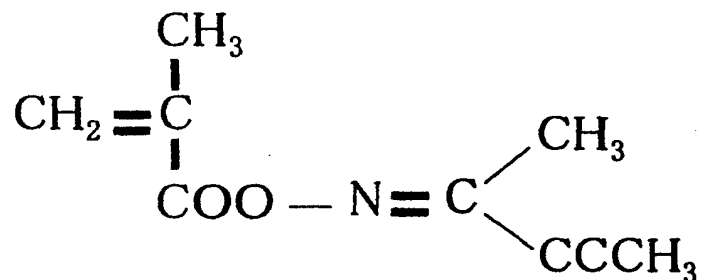


7. A method for producing a fine structured member according to claim 6, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

8. A method for producing a fine structured member according to claim 6, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

9. A method for producing a fine structured member according to claim 1, wherein said factor for expanding the sensitivity region is methyl 3-oximino-2-butanone methacrylate represented by a

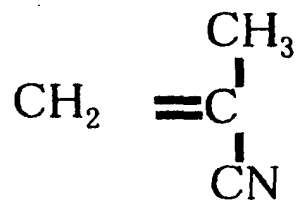
following formula:



10. A method for producing a fine structured member according to claim 9, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

11. A method for producing a fine structured member according to claim 9, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

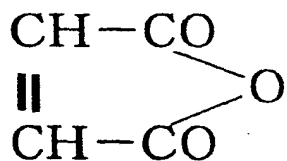
12. A method for producing a fine structured member according to claim 1, wherein said factor for expanding the sensitivity region is methacrylonitrile represented by a following formula:



13. A method for producing a fine structured member according to claim 12, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

14. A method for producing a fine structured member according to claim 12, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

15. A method for producing a fine structured member according to claim 1, wherein said factor for expanding the sensitivity region is fumaric anhydride represented by a following formula:



16. A method for producing a fine structured member according to claim 15, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and
5 is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

17. A method for producing a fine structured
10 member according to claim 15, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

18. A method for producing a fine structured
15 member according to claim 1, wherein a first positive-working photosensitive material includes a photodegradable resin having at least a carboxylic acid anhydride structure.

20 19. A method for producing a fine structured member according to claim 18, wherein the first positive-working photosensitive material is an acrylic resin which is subjected to an intermolecular crosslinking through the carboxylic acid anhydride
25 structure.

20. A method for producing a fine structured

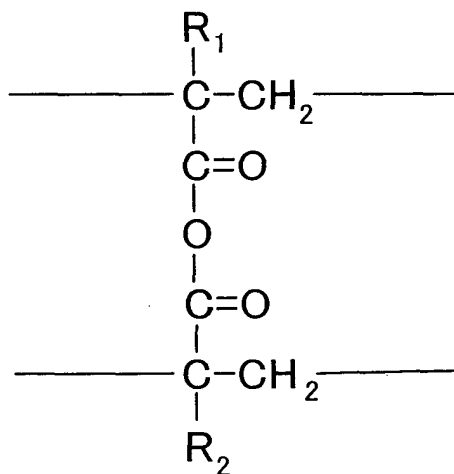
member according to claim 19, wherein the first positive-working photosensitive material is an acrylic resin having an unsaturated bonding in a side chain.

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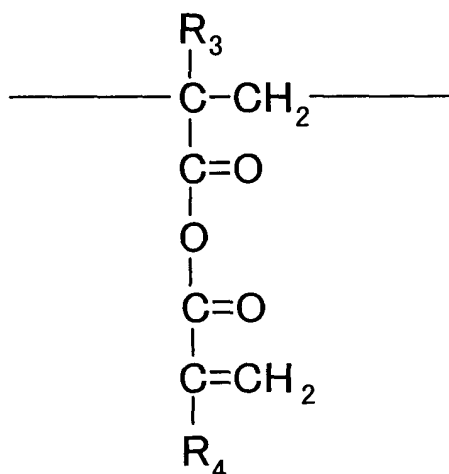
21. A method for producing a fine structured member according to claim 19, wherein the first positive-working photosensitive material includes a structural unit represented by following general

10 formulas 1 and 2:

general formula 1



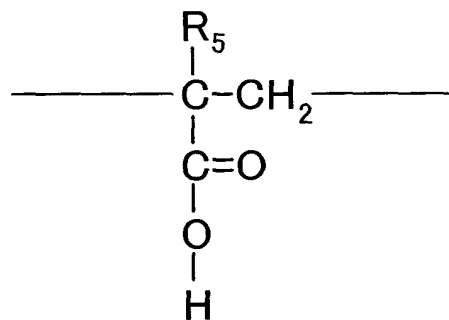
general formula 2



wherein R₁ to R₄, which may be mutually same or different, each represents a hydrogen atom or an alkyl group with 1 to 3 carbon atoms.

22. A method for producing a fine structured member according to claim 21, wherein the first positive-working photosensitive material includes a structural unit represented by a following general formula 3:

general formula 3



wherein R₅ represents a hydrogen atom or an alkyl

group with 1 to 3 carbon atoms.

23. A method for producing a fine structured member according to claim 1, wherein a first
5 wavelength region is of a shorter wavelength than a second wavelength region.

24. A method for producing a fine hollow structured member on a substrate comprising:
10 a step of forming a positive-working photosensitive material on a substrate;
a step of heating the layer of said positive-working photosensitive material thereby crosslinking said positive-working photosensitive material layer;
15 a step of executing an irradiation with an ionizing radiation of a first wavelength region capable of decomposing said crosslinked positive-working photosensitive material layer on a predetermined area of said crosslinked positive-
20 working photosensitive material layer; and
a step of removing, by a development, the area irradiated by the ionizing radiation of said crosslinked positive-working photosensitive material layer from the substrate, thereby obtaining a mold
25 pattern formed by a non-irradiated area by the ionizing radiation of said crosslinked positive-working photosensitive material layer;

a step of forming a covering resin layer,
formed by a negative-working photosensitive material
sensitive to a second wavelength region, in a
position covering at least a part of the mold pattern
5 on said substrate;

a step of irradiating said covering resin layer
with an ionizing radiation of the second wavelength
region thereby hardening said covering resin layer;
and

10 a step of removing, by dissolution, the mold
pattern covered by said hardened covering resin layer
from the substrate thereby obtaining a hollow
structure corresponding to said mold pattern;

wherein said positive-working photosensitive
15 material includes a ternary copolymer containing
methyl methacrylate as a main component, methacrylic
acid as a thermally crosslinkable factor and a factor
for expanding a sensitivity region for said ionizing
radiation; and

20 said first wavelength region and said second
wavelength region do not overlap mutually.

25 25. A method for producing a fine hollow
structured member according to claim 24, wherein the
crosslinking by said heat treatment is caused by a
dehydration condensation reaction.

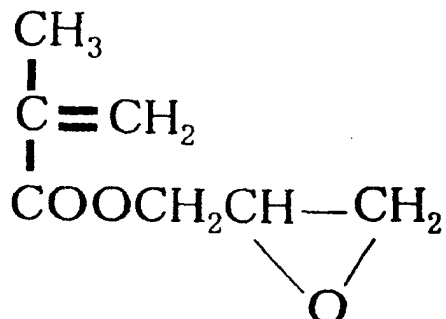
26. A method for producing a fine hollow structured member according to claim 24, wherein said factor for expanding the sensitivity region is methacrylic anhydride.

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27. A method for producing a fine hollow structured member according to claim 26, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said
10 copolymer, and is prepared by a radical polymerization of cyclized polymerization type at a temperature of 100 to 120°C employing an azo compound or a peroxide as a polymerization initiator.

15 28. A method for producing a fine hollow structured member according to claim 26, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

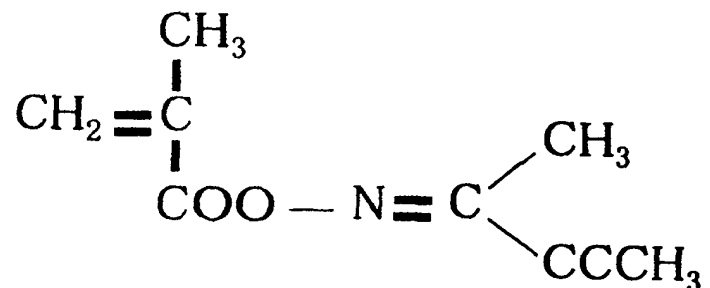
20 29. A method for producing a fine hollow structured member according to claim 24, wherein said factor for expanding the sensitivity region is glycidyl methacrylate represented by a following formula:



30. A method for producing a fine hollow structured member according to claim 29, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

31. A method for producing a fine hollow structured member according to claim 29, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

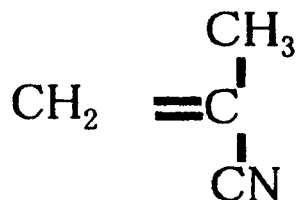
32. A method for producing a fine hollow structured member according to claim 24, wherein said factor for expanding the sensitivity region is methyl 3-oxyimino-2-butanone methacrylate represented by a following formula:



33. A method for producing a fine hollow structured member according to claim 32, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

34. A method for producing a fine hollow structured member according to claim 32, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

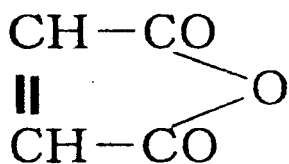
35. A method for producing a fine hollow structured member according to claim 24, wherein said factor for expanding the sensitivity region is methacrylonitrile represented by a following formula:



36. A method for producing a fine hollow structured member according to claim 35, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

37. A method for producing a fine hollow structured member according to claim 35, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

38. A method for producing a fine hollow structured member according to claim 24, wherein said factor for expanding the sensitivity region is fumaric anhydride represented by a following formula:



39. A method for producing a fine hollow structured member according to claim 38, wherein said ternary copolymer includes methacrylic acid in a proportion of 2 to 30 wt.% with respect to said
5 copolymer, and is prepared by a radical polymerization at a temperature of 60 to 80°C employing an azo compound or a peroxide as a polymerization initiator.

10 40. A method for producing a fine hollow structured member according to claim 38, wherein said ternary copolymer has a weight-averaged molecular weight within a range from 5,000 to 50,000.

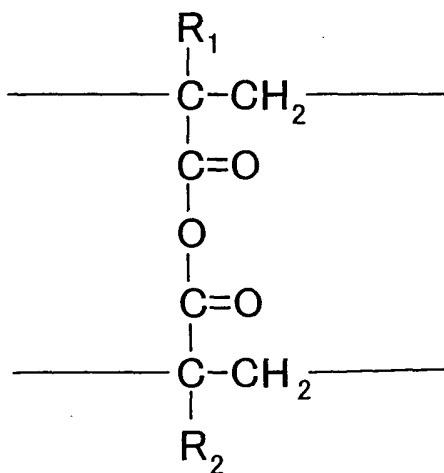
15 41. A method for producing a fine hollow structured member according to claim 24, wherein a first positive-working photosensitive material includes a photodegradable resin having at least a carboxylic acid anhydride structure.

20 42. A method for producing a fine hollow structured member according to claim 41, wherein the first positive-working photosensitive material is an acrylic resin which is subjected to an intermolecular
25 crosslinking through the carboxylic acid anhydride structure.

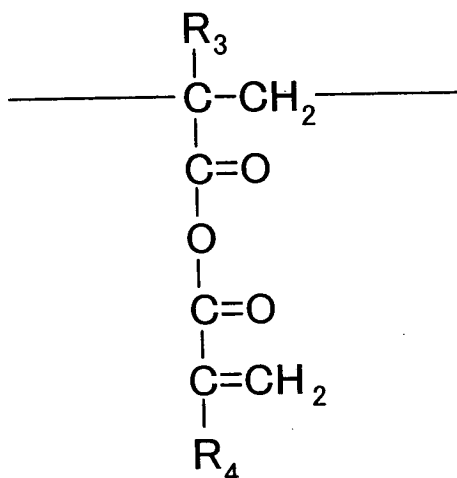
43. A method for producing a fine hollow structured member according to claim 42, wherein the first positive-working photosensitive material is an acrylic resin having an unsaturated bonding in a side
5 chain.

44. A method for producing a fine hollow structured member according to claim 42, wherein the first positive-working photosensitive material
10 includes a structural unit represented by following general formulas 1 and 2:

general formula 1



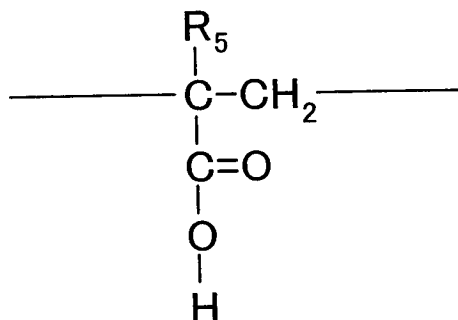
general formula 2



wherein R₁ to R₄, which may be mutually same or different, each represents a hydrogen atom or an alkyl group with 1 to 3 carbon atoms.

45. A method for producing a fine hollow structured member according to claim 44, wherein the first positive-working photosensitive material includes a structural unit represented by a following general formula 3:

general formula 3



wherein R₅ represents a hydrogen atom or an alkyl

group with 1 to 3 carbon atoms.

46. A method for producing a fine hollow
structured member according to claim 1, wherein the
5 first wavelength region is of a shorter wavelength
than the second wavelength region.

47. A method for producing a fine hollow
structured member according to claim 1, wherein said
10 negative-working photosensitive material includes an
epoxy resin as a principal component.

48. A method for producing a liquid discharge
head comprising steps of forming a mold pattern with
15 a removable resin in a portion where a liquid flow
path is to be formed on a substrate on which a liquid
discharge energy generating element is formed;
coating and hardening a covering resin layer on said
substrate so as to cover said mold pattern; and
20 removing by dissolution said mold pattern thereby
forming a liquid flow path having a hollow structure;
wherein said liquid flow path is formed by a
method for producing a fine hollow structure
according to any one of claims 24 to 47.

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49. A method for producing a liquid discharge
head according to claim 48, wherein a developing

liquid containing at least:

1) a glycol ether having 6 or more carbon atoms
and miscible with water in an arbitrary ratio;

2) a nitrogen-containing basic organic solvent;

5 and

3) water

is used for developing said mold pattern.

50. A method for producing a liquid discharge
10 head according to claim 49, wherein said glycol ether
is ethylene glycol monobutyl ether and/or diethylene
glycol monobutyl ether.

51. A method for producing a liquid discharge
15 head according to claim 50, wherein said nitrogen-
containing basic organic solvent is ethanolamine
and/or morpholine.